INSTALLING AN ASSET MANAGEMENT SYSTEM? DON'T FORGET THE DISCRETES! (PART 2)

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Asset Management (AM) systems are now being used in concert with analog instruments and modulating control valves to analyze their performance and optimize maintenance. However, there have been few initiatives to integrate discrete automated control valves into these systems.

This is the second part of a two part series describing what you can do to take advantage of diagnostic systems for discrete automated valves. In Part 1 I discussed the problems that may occur in most discrete (On/Off) valve systems and the challenges instrument engineers face in diagnosing these problems. In part 2 I'll describe potential solutions based on your current legacy systems or using emerging technologies with a comprehensive diagnostic capability.

Analyzing Discrete Valve Problems with Existing Hardware

As discussed in Part 1 the three primary failure conditions for discrete automated valves are:

1. Process valve leaks excessively
2. Solenoid valve fails
3. Process valve sticks in one position

Before we start looking at more complex diagnostic systems lets see if we can anticipate some of these problems with systems you probably have installed today.

If you have a contemporary valve monitor with two limit switches and a pneumatic solenoid pilot located at the valve actuator, you probably already have the capability to collect a significant amount of performance information. You can readily obtain:

- Open Dead time (Time from energizing solenoid to break full closed limit)
- Open time (Time from energizing solenoid to make open limit)
- Close Time (Time from de-energizing solenoid to make closed limit)
- Close Dead time (Time from de-energizing solenoid to break full closed limit)

What needs to be done is to put together this data in a manner that provides you with useful trending information in order to anticipate some of the primary failure conditions.

(3) Process valve sticks in one position – On a valve that cycles periodically, there may be a number of clues that indicate it is susceptible to sticking. It may have an increasing dead time, open time and/or close time trend. Although the open or close time may not have been sufficient to trip an alarm, an increasing trend of dead, open or closed time may clearly indicate a potential to stick. However, if a valve begins to show an increasing time trend this does not indicate what the source of the problem may be. It could be a number of problem sources including a partially clogged or faulty solenoid valve, low air pressure, a failing actuator or the process valve beginning to stick (also for a number of reasons).

(2) Solenoid valve fails – a solenoid pilot valve may fail from many causes. It may become clogged with air line contaminants, it's coil may burn out or it may have insufficient pressure to name a few. A partially clogged solenoid pilot may be indicated with an increasing open time trend as mentioned earlier. However, other problems may be difficult to determine, much less anticipate, without more comprehensive diagnostics.

(1) Process valve leaks excessively – This is the most frequent cause of automated discrete valve failures. Unfortunately, this may be the most difficult problem to anticipate without removing the valve from the process line. Here again, depending on the application, the valve opening, closing and dead time trends may offer some predictive guidance on the valve's condition. Time trends may decrease for a worn ball valve which takes less torque due to worn seats while a soft seat butterfly valve with an increasing dead time trend could indicate a swollen seat. Plug valves tend to have increasing opening or closing time trends (Provided the supply pressure is consistent).

By loading ongoing operating data into a database and plotting as described above some useful trends may be evaluated without spending a dime on additional equipment. These trends may provide some useful clues for preventative maintenance. However, by using only this information, there are many potential problem sources to be evaluated before effective repair. If you would like to get a better understanding of what is happening at your discrete automated valve and be able to effectively identity problem causes, you need to take the next step in going to a comprehensive diagnostic system.

Putting a Comprehensive Diagnostic System Together

The ideal solution for performing diagnostics consists of three main parts:

A. Valve communication terminal (VCT) with integrated pneumatic pilot valve to monitor and control the discrete automated valve system.
B. Communication network linking the VCT to the control system
C. Diagnostic software to analyze data and provide key maintenance information and alarms

Of course, all three elements have to work together in order to have your diagnostic system provide any benefits. And, it is beneficial to have your diagnostic software push critical alerts to your operating system to prevent a process shut-down.

(A) VCTs not only provide standard open and closed limit feedback and operate the pneumatic pilot valve but also may be fitted with auxiliary sensors for supply and actuator port air pressure and solenoid coil current. In addition to the open, closed and dead time trends mentioned earlier, you can now examine pressure changes in the supply line and across the actuator piston to understand the actuator's changing torque requirements. By monitoring the differential pressure (actuator torque), variability in supply pressure does not factor into many of the potentially detected problems. In addition, torque trends directly correlate to valve seat, bearing, and linkage wear. As a result much greater insight can be gained into potential problems and possible problem causes.

Solenoid valve health may be quickly and accurately determined by sampling coil current and observing pneumatic pressure changes in the valve. If the pneumatic pilot valve is stuck that information can be readily transmitted.

This additional information must be transmitted from the field to the DCS over a communication medium (B). If more analysis is performed at the VCT, a simple communication protocol such as AS-Interface may provide many of the diagnostic answers e.g. solenoid pilot valve failure alert; insufficient air supply alert, torque limit alert. This may be done by cleverly assigning a few of the I/O bits to the alerts at the VCT and mapping the alert tags to the HMI (C). This may be a very cost effective way of creating operator awareness of a potential or materializing problem and identifying specifically where the problem is located. Simple protocols such as AS-Interface and DeviceNet would be capable of transmitting this rudimentary information and offer the potential to reduce capital costs dramatically from conventionally wired applications.

Using Standardized Diagnostic Technologies

For a more sophisticated diagnostic system enabling you to look into the many different variables at the VCT with standardized software on the DCS, a number of new systems are materializing. Those systems include FDT (Field Device Tool) technology which has been around for a few years and/or enhanced EDDL (Electronic Device Description Language) which is now emerging.

The FDT concept uses a frame application which resides on the host DCS. The frame application opens the field device (In our case VCT) driver called a DTM (Device Type Manager). The DTM for the VCT is typically provided by the vendor. In order to properly plug data into the DTM on the host system, a communication DTM must exist for each of the protocols used to link the VCT to the DCS system. Currently communication DTMs are available for Foundation Fieldbus, HART, Profibus DP & PA. User-groups are now working on development for DeviceNet, AS-Interface and other protocol communication DTMs which promise to be available soon.

With FDT technology, DTMs are created by the VCT vendor with the preconfigured charts so data would load properly to create the valve system operating characteristics. From these trends analysis may be performed and alerts may be pushed to the operating system.

EDDL is a text based language for describing diagnostic data, configuring the device and providing device status. The host system would create a graphic and load data into that graphic based on the devices EDDL file. Currently Foundation Fieldbus, HART and Profibus DP and PA are supporting EDDL technology.

With EDDL, the graphics for trending would be described by the VCT vendor. The DCS host would create the appropriate graphics (manually or automatically depending on the level of EDDL capability) and have data loaded appropriately so an HMI would be created to review diagnostic information.

FDT technology is currently being deployed by a number of DCS vendors and EDDL is being adopted rapidly as well. In a “hybrid” model some DCS vendors using FDT technology are creating DTMs for specific field devices using the EDDL file from the field device vendor so they will be able to run with either technology.

Conclusion

For legacy applications, organizing existing data now being collected from your automated discrete valve into open, closed and dead time trends may reveal some beneficial diagnostic trends. No new hardware is required and this solution may offer significant potential for creating immediate savings.

For new applications, using a VCT with a simple protocol such as AS-Interface or DeviceNet may be the best solution. Key problem locators and diagnostic alerts (Solenoid valve malfunction, solenoid coil malfunction, insufficient air supply pressure, excessive torque limit) may be mapped into the HMI software to enable operators to quickly and effectively respond to field problems. Open, closed and dead time trends may also be created to get a look at the automated valve system health. And, this solution may save money up front due to the installation cost reduction over conventional wiring.

The ultimate in standardized diagnostics for your discrete automated valve would be taking advantage of technologies such as FDT and/or EDDL. Most DCS vendors are beginning to integrate these technologies into their standard offering to make universal diagnostic systems for both analog and discrete instruments. They offer the ultimate in field instrument visibility and eliminate the need for any special “add-on” software. However, in order to use these technologies, you need to be sure that all of the elements are in place. In the case of FDT that includes DTMs for the VCT, communication DTMs for each Protocol used and a host system frame application. For EDDL, the VCT must include an EDDL file with a compatible protocol and the host system needs to have graphics developed or capability to automatically develop graphics based on the EDDL file.

Questions or comments pertaining to this article are welcome, and can be forwarded by e-mail to:

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